Assessment of Air Quality in the International Space Station (ISS) and Space Shuttle Based on Samples Returned aboard STS-111 (UF2) in June 2002

The toxicological assessments of grab sample canisters (GSCs) and 2 solid sorbent air samplers (SSASs) returned aboard STS-111 are reported. Analytical methods have not changed from earlier reports. Surrogate standard recoveries from the GSCs were 86-106%, and 62% to 136 % from the SSASs; 2 tubes with low surrogate recoveries were not reported. Pressure tracking indicated no leaks in the canisters during analysis. Recoveries from lab and trip controls for formaldehyde analyses ranged from 87 to 96%.

The two general criteria used to assess air quality are the total-non-methane-volatile organic hydrocarbons (NMVOCs) and the total T-value (minus the CO_2 and formaldehyde contributions). Because of the inertness of Freon 218 (octafluoropropane, OFP), its contribution to the NMVOC is subtracted and tabulated separately. Control of atmospheric alcohols is important to the water recovery system engineers, hence total alcohols (including acetone) are also shown for each sample. Because formaldehyde is quantified from sorbent badges, its concentration is listed separately. These five indices of air quality are summarized below:

Sample Location	Date	NMVOCs - OFP (mg/m^3)	OFP (mg/m^3)	T Value[a] (units)	Alcohols (mg/m^3)	Formaldehyde (mg/m^3)
Lab SSAS	12/27/01	8.5	n/a[b]	0.77	3.2	0.045
SM SSAS	12/27/01	7.6	n/a	0.72	1.9	0.022
Lab SSAS	1/22/02	8.2	n/a	0.69	2.4	0.044
SM SSAS	1/22/02	9.4	n/a	0.92	1.8	0.034
Lab SSAS	2/28/02	7.9	n/a	0.54	3.2	0.046
SM SSAS	2/28/02	10.0	n/a	**1.05**	1.5	0.033
Lab SSAS	3/27/02	8.6	n/a	0.67	2.6	**0.060**
SM SSAS	3/27/02	*SSAS sample did not pass QA/QC*				0.027
Lab GSC	4/24/02	3.6	14	0.24	2.8	0.043
SM GSC		*valve left open after sample acquired-no analysis performed*				0.031
Lab SSAS	4/24/02	7.0	n/a	0.67	2.0	0.043
SM SSAS	4/24/02	8.9	n/a	0.73	3.5	0.031
Lab SSAS	5/22/02	10.5	n/a	0.80	3.6	0.044
SM SSAS	5/22/02	*SSAS sample did not pass QA/QC*				0.029
SM GSC	5/23/02	5.6	19	0.66	4.5	0.029
Lab GSC	5/23/02	6.9	16	0.42	4.2	0.044
MPLM 1 GSC	6/08/02	15.0	0.0	**1.42**	**7.5**	ns[c]
Shuttle Preflight	6/05/02	0.4	n/a	0.02	0.1	ns
Shuttle Middeck		*end of mission sample not collected*				
Acceptable Guideline:		<25	85000	<1	<5[d]	0.050

[a] Formaldehyde and CO2 not included in T calculation.
[b] n/a = not in analysis plan for SSAS or preflight samples
[c] ns = no sample
[d] New guideline based on memo MSFC FD21 (03-012), November 2002 (Perry)

The table shows that the air quality in general was acceptable for crew respiration; however, certain values shown in bold require further explanation. The 1.05 T value on 2/28/02 was caused by an unusually high measurement of hexamethylcyclotrisiloxane (T value = 0.50), which is not a concern. The MPLM T value of 1.42 and the alcohol level of 7.5 mg/m^3 were due to an overall polluted atmosphere, which was expected at first entry. The major T-value component was

carbon monoxide at a contribution of 0.44 units. Since the crew was only exposed momentarily to the polluted atmosphere, no health effects are expected. The formaldehyde value of 0.060 mg/m^3 found in the Lab sample from 3/27/02 is cause for concern because the Lab consistently shows higher concentrations of formaldehyde than the SM and occasionally the concentrations are above the acceptable guideline.

Levels of OFP have remained low, suggesting that no further leaks of the SM air conditioner have occurred.

Enclosures
1A: Analytical Results of STS-111/UF2 GSC Samples
1B: Analytical Results of ISS Increment 4 SSAS returned on UF2
2A: T Values of STS-111/UF2 GSC Samples
2B: T Values of ISS Increment 4 SSAS returned on UF2